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(54) Pressure measuring device

(57) A pressure measuring device 1 comprises a tubular body 2 with a flat end plate 3 in one end and a threaded connector end member 4 on the other end. The end plate 3 has a window aperture 6 for viewing a liquid crystal display 7, an ON-OFF switch 8 operable from outside the body but connected to circuitry within, and an electrical connection socket 9 by which a plug external to the body can also be connected to the circuitry within. The end member 4 has a central threaded bore 10 to which a source of pressure to be measured can be attached, and which leads into a recess in which is clamped by a plug 11 a pressure transducing element 12 sealed by an O-ring 13. The liquid crystal display 7 is mounted on a printed circuit board 14 by a bezel 15. The board 14 and LCD 7 are mounted on the end plate 3 by screws 19 which extend beyond the board 14 to carry a second printed circuit board 22 which carries a drive circuit for the LCD. Wires 33 interconnect the boards 14 and 22 electrically and directly, although the boards remain physically spaced. The tubular body 2 also contains a carrier 39 for a rechargable battery 42 and a third printed circuit board 32 is secured to the carrier parallel to the length of the body and electrically connected to the second board 22 and to the transducing element 12. The socket 9 provides an output for the transducer signal and a connection to recharge the battery.

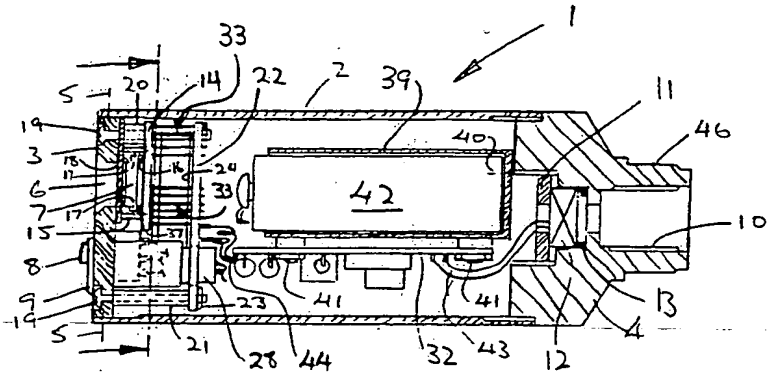

FIGURE 1

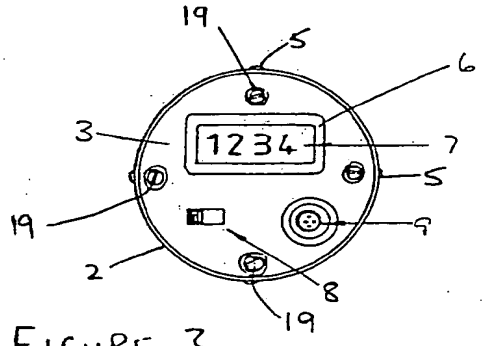

FIGURE 3

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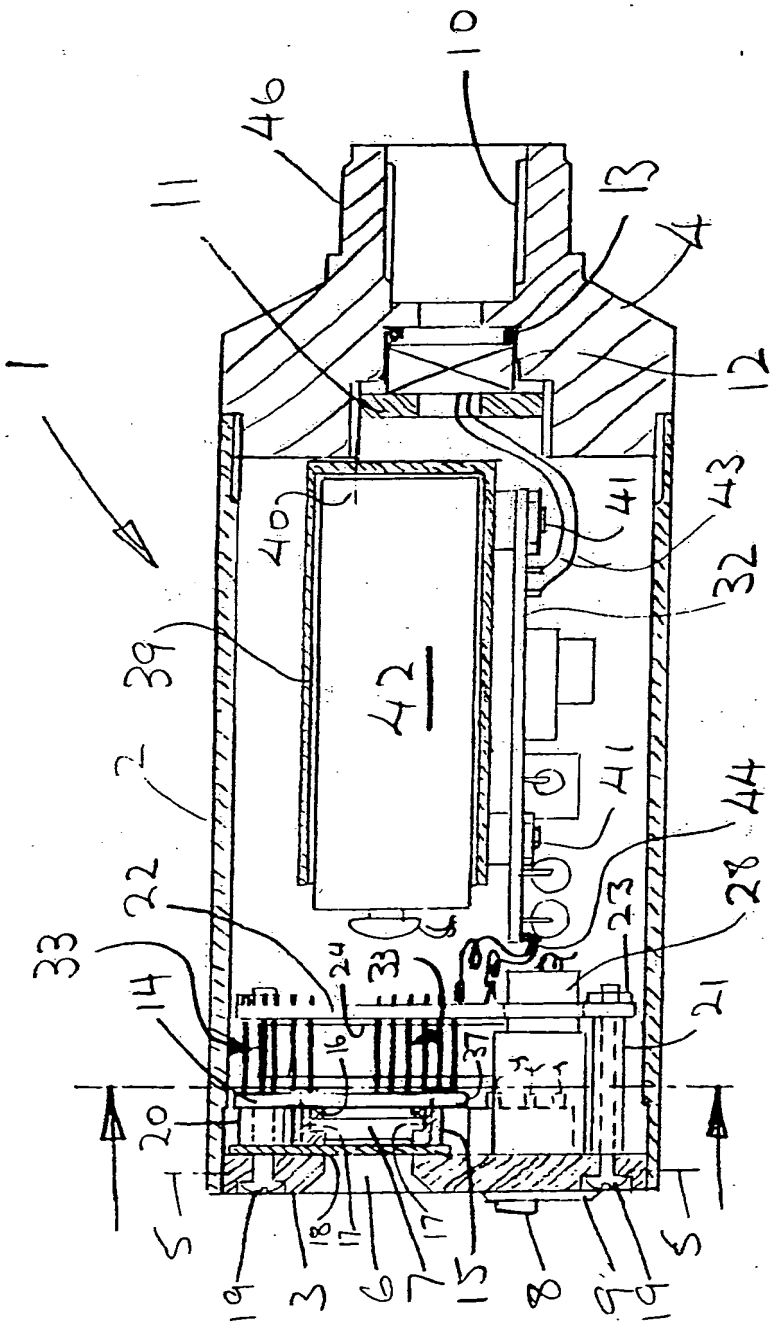

FIGURE 1

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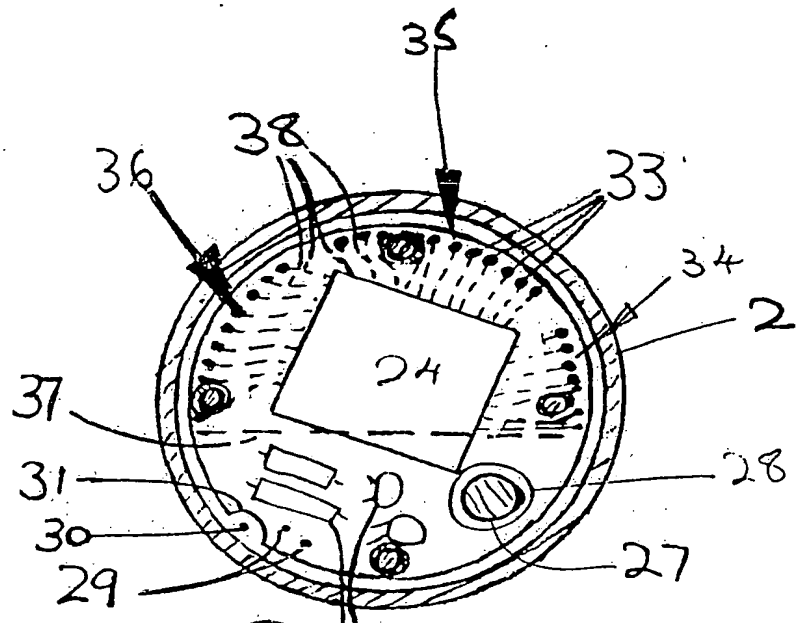

FIGURE 2

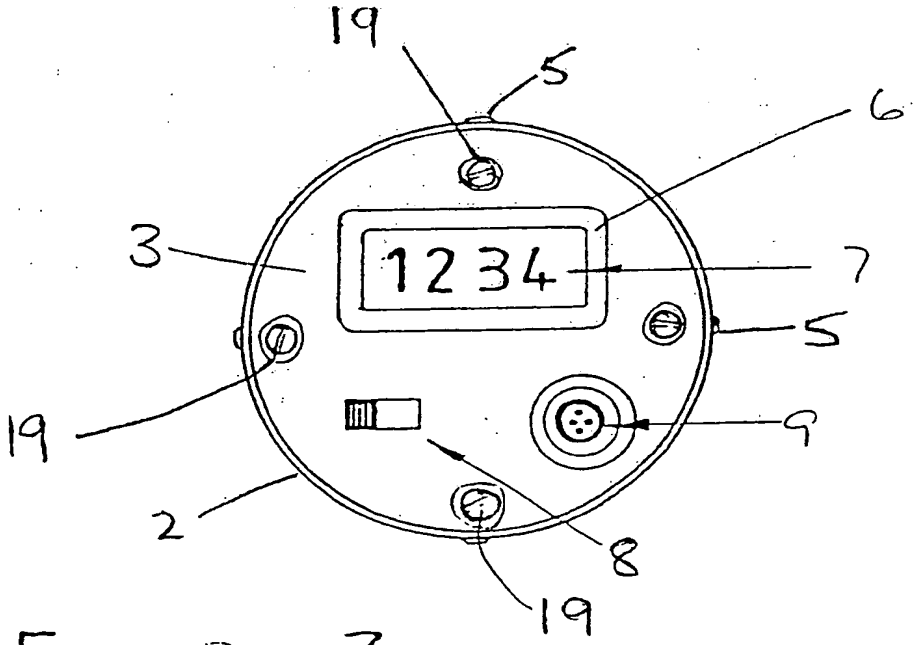

FIGURE 3

SPECIFICATION

Pressure measuring device

The present invention relates to a pressure measuring device.

The invention has been made following the inventor's concept that a self-contained, digital-read-out pressure gauge would be a commercially useful device.

Conventionally self-contained Bourdon tube type pressure gauges are very well known. Pressure transducers, in which a resistive element's resistance changes as a function of applied pressure, are also well-known. However, these cannot be used in a self-contained manner since at least a source of electricity, an electrical meter and usually an amplifier are required in addition.

The packaging of these additional items in a convenient form, particularly where the meter is to have a digital read-out provides problems. In particular, where the device is to be robust, easily handled and easily connected/disconnected it is convenient that it should have a generally tubular body with the display on one end face and a pressure connection on the other end face. To meet these criteria, the display end face and the body should have a transverse dimension such that they can be gripped within a man's hand. Where the display is a liquid crystal display ("LCD") this dimensional constraint precludes the mounting of it and its drive circuit on the same printed circuit board ("PCB").

The object of the invention is to provide a pressure measuring device in which these problems are overcome and the criteria are met.

The pressure measuring device of the invention comprises:—

a tubular body;

one endmember secured to one end of the body;

another end member secured to the other end and adapted for pressure tight connection to a source of pressure;

a pressure transducing member sealingly mounted to the other end member;

a liquid crystal display ("LCD") mounted at the one end member;

an LCD printed circuit board ("LCD-PCB"), to which the LCD is electrically connected, mounted inwardly of the one end member;

a second printed circuit board ("2nd PCB") mounted inwardly of the LCD-PCB and carrying a drive circuit for the LCD; and

direct wire connections extending between the LCD-PCB and the 2nd PCB, whereby the two printed circuit boards are united, whilst remaining physically spaced.

The tubular body is preferably of circular cross-section, although other shapes are possible. The presently preferred outside diameter is 44 mm, although substantial variations from this can be made without difficulty being experienced in manual gripping. Again in the preferred embodiment the tubular body is approximately twice as long as its transverse diameter, but this ratio can be substantially altered, even to the extent of being reversed.

The adaption for pressure tight connection is conveniently a screw connection, although a snap connection may be provided.

The LCD is conveniently mounted on the LCD-PCB in a conventional manner with a bezel and zebra strips as described below with reference to the accompanying drawings. To secure the LCD-PCB to the end member, the former may be fixed to the latter by screws or threaded studs. The 2nd PCB may be similarly secured. Alternatively, where as is preferred the direct wires are soldered to both boards due to the number of wires the 2nd PCB may require no securing to the end member. However it is conveniently fixed to the end member by screws or studs to steady the wires during soldering and to stabilize any cantilevered portion otherwise unsupported.

The one end member preferably includes an ON-OFF switch, the space occupied by which aggravates the problem of lack of room on the LCD-PCB for the drive circuit. Additionally a transducer output/battery charging socket is also provided in the one end member, causing further congestion.

A third PCB is preferably provided for a circuit to condition the transducer output signal. The normally expected requirement for the 3rd PCB separate from the 2nd PCB is again caused by lack of available area of the 2nd PCB. The 3rd PCB could, in common with the LCD-PCB and the 2nd PCB, be arranged parallel to the one end member. However since a relatively few connections are required between the 2nd and 3rd PCBs the 3rd PCB is conveniently arranged parallel to the length of the tubular body. Conveniently it is mounted on a support for a rechargeable battery, the support being secured to the other end member.

To help understanding of the invention, a specific embodiment thereof will now be described by way of example and with reference to the accompanying drawings, in which:—

Figure 1 is a central cross-sectional side view of a measuring device of the invention;

Figure 2 is a cross-sectional end view on the line II—II in Fig. 1; and

Figure 3 is an end view similar to that of Fig. 3.

The measuring device 1 of the invention comprises a stainless steel tubular body 2 with a stainless steel end plate 3 at one end and end member 4 at the other end. The end plate 3 is secured to the tubular body 2 by screws 5 (shown by their axes in Fig. 1) whilst the end member 4 is threadedly connected to the body 2.

The end plate 3 has a window aperture 6

for viewing an LCD 7, an ON/OFF switch 8 and an electrical connection socket 9. The end member 4 has a central threaded bore 10 to which is clamped by a plug 11 a pressure transducing element 12 which closes the bore 10 with the aid of an O-ring seal 13.

The LCD 7 is mounted on an LCD-PCB 14 via a bezel 15, with electric contact being made via a so-called zebra strip 16. The bezel is secured by countersunk head screws (not shown) on axes 17. Closing the window aperture 6 is an acrylic screen 18 sealed with silicone sealing compound to the end plate 3. The end plate 3 has four recessed bores for screws 19, three of which pass through both the screen 18 and the LCD-PCB 14, with the interposition of spacers 20, for securing them. The screws continue with further suitable spacers 21 to secure a 2nd PCB 22 with the aid of nuts 23.

The 2nd PCB carries an integrated circuit 24, for driving the LCD 7, together with associated resistors and capacitors 26. The body 27 of the socket 9 passes through the 2nd PCB 22 via an aperture 28, whilst two leads 29 from the switch 8 are connected to the 2nd PCB 22 and a third 30 passes via notch 31 to a 3rd PCB 32.

The sub-assembly of items attached to the end plate 3 is assembled in the following sequence. The LCD, bezel and zebra strips are first assembled to the LCD-PCB. Then twenty-five short wires 33 arranged in three groups of seven 34, nine 35 and nine 36 are soldered to pads of the LCD-PCB at corresponding holes arranged around the circular circumference of the LCD-PCB, which is sized to fit with clearance in the tubular body 2. It should be noted that the LCD-PCB 14 is not fully circular, the lower segment being cut off at edge 37 to allow space for the switch 8 and socket 9. The wires 33 extend away from the LCD side of the PCB 14. The latter is assembled to the end plate 3 with the interposition of the screen 18 via the screws 19 and spacers 20. The further spacers 21 having been placed on the screws 19, the 2nd PCB 22 and the nuts 23 are added. The wires 33 are all fed through respective holes in the 2nd PCB and the nuts are tightened; whereupon the wires 33 are soldered to their respective pads on the 2nd PCB 22. Thus the two PCBs 14,22 are united both electrically and mechanically by the wires 33 which in the absence of the screws 19 would now maintain the relative positioning of the PCB. Prior to assembly of the 2nd PCB to the screws 19 and wires 33, the integrated circuit 24 and components 26 were assembled and soldered to the 2nd PCB 22. The details of the tracks on the PCBs are not shown save the twenty-five tracks 38 providing connection from the integrated circuit 24 to the wires 33 and thence to the LCD 7.

Attached to the inner surface of the end member 4 is a rechargeable-battery carrier 39 by screws not shown on axes 40. The carrier supports via nuts, bolts and spacers 41 the 3rd PCB 32 and the rechargeable battery 42. The third PCB carries a voltage regulation circuit and a signal conditioning circuit for producing an analogue voltage signal proportional to the change of resistance of the transducing element 12 with applied pressure. The 3rd PCB is connected to the element 12 on wires 43 and passes the analogue signal on wires 44 to the integrated circuit 24, which can be a 7136 MAXIM circuit incorporating an analogue to digital converter as well as an LCD drive. The wires 44 are of sufficient length that when the sub-assembly on the end member 4 has been assembled to it together with the tubular body 2, the wires 44 can be connected to the sub-assembly on the end plate 3 which can then be positioned in the end of the body 2 and secured there by radial screws 5 with the wires 44 forming loops within the body.

The suitable circuits for voltage regulation, signal conditioning and operating the integrated circuit 24 are believed to be within the knowledge of the man skilled in the art and will not be described.

In use the device is readily connected to a source of pressure via the threaded bore 10, with the aid of hexagonal flats 46 and pressure read at the LCD once the device is switched ON. Recharging of the battery 42 can be achieved via one pair of terminals in the socket 9 which are wired across the battery terminals via short-circuit protection diodes, whilst a direct connection across the transducing element 12 can be made via the other pair of terminals if it is desired to use the device as a transducer, with or without its own display.

The invention is not intended to be restricted to the details of the above described embodiment. For instance, the ON/OFF switch may be arranged to switch the internal battery OFF and to switch the device circuitry to be operated from the socket terminals in the OFF or EXTERNAL position.

CLAIMS

1. A pressure measuring device comprising:—

a tubular body;

one end member secured to one end of the body;

an other end member secured to the other end of the body and adapted for pressure-tight connection to a source of pressure to be measured;

a pressure transducing member sealingly mounted to the other end member;

a liquid crystal display ("LCD") mounted in the one end member;

an LCD printed circuit board ("LCD-PCB"), to which the LCD is electrically connected,

mounted within the body inwardly of the one end member;

a second printed circuit board ("2nd PCB") mounted within the body inwardly of the LCD-PCB and carrying a drive circuit for the LCD; and

direct wire connections extending between the LCD-PCB and the 2nd PCB, whereby the two printed circuit boards are united, whilst remaining physically spaced.

2. A device as claimed in claim 1, wherein the tubular body is of circular cross-section.

3. A device as claimed in claim 1 or 2, wherein the tubular body is approximately twice as long as wide.

4. A device as claimed in claim 1,2 or 3, wherein the pressure-tight connection is a screw connection.

5. A device as claimed in claim 1,2 or 3, wherein the pressure-tight connection is a snap connection.

6. A device as claimed in any preceding claim, wherein the LCD is mounted on the LCD-PCB and the latter secured to the one end member.

7. A device as claimed in claim 6, wherein the LCD-PCB is fixed to the one end member by screws or threaded studs.

8. A device as claimed in claim 6 or 7, wherein the 2nd PCB is secured to the one end member.

9. A device as claimed in any preceding claim, wherein the body is adapted to contain a battery and electrical connections between the battery and the drive circuitry.

10. A device as claimed in claim 9, wherein the battery is rechargeable.

11. A device as claimed in claim 10, wherein the one end member carries a battery charging socket.

12. A device as claimed in any preceding claim, wherein the pressure transducing member is connected to an output in the one end member.

13. A device as claimed in claim 12, as appendant to claim 11, wherein the transducing member output is in the battery charging socket.

14. A device as claimed in any preceding claim, wherein a circuit to condition the transducing member output signal is provided on a third printed circuit board ("3rd PCB").

15. A device as claimed in claim 14, wherein the 3rd PCB is mounted within the body parallel to the length thereof.

16. A device as claimed in claim 15, as appendant to claim 10, or any claim appendant to claim 10, wherein the 3rd PCB is mounted on a support for the rechargeable battery, the support being secured to the other end member.

17. A pressure measuring device substantially as hereinbefore described with reference to the accompaning drawings.

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